

(12) UK Patent Application (19) GB (11) 2 170 792 A

(43) Application published 13 Aug 1986

(21) Application No 8602909

(22) Date of filing 6 Feb 1986

(30) Priority data

(31) 699310

(32) 7 Feb 1985

(33) US

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(51) INT CL⁴

G07F 11/04

(52) Domestic classification (Edition H):

B8U 500 AG

U1S 1809 B8U

(56) Documents cited

None

(58) Field of search

B8U

Selected US specifications from IPC sub-class G07F

(54) Vended product sensor and method

(57) The product (12) drops from a stack (11) onto a delivery chute (13) or other product receiving member, and the delivery of a product is determined by detecting the impact of the product on the delivery chute. In one disclosed embodiment, the impact detector comprises a piezoelectric element mounted on the delivery chute, and in other embodiments it comprises a strain gauge, a sound detector, or an accelerometer.

The invention has application to vending machines for soft drinks and the like.

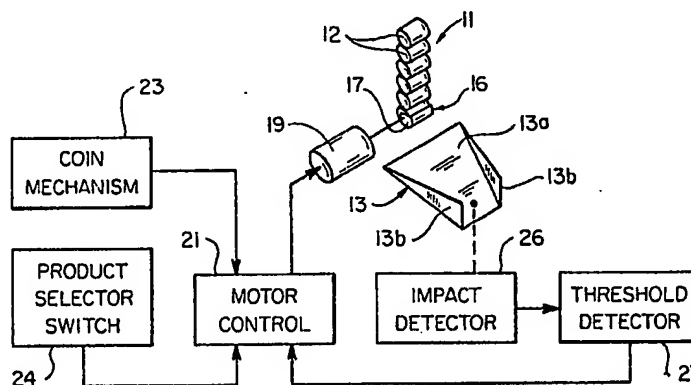
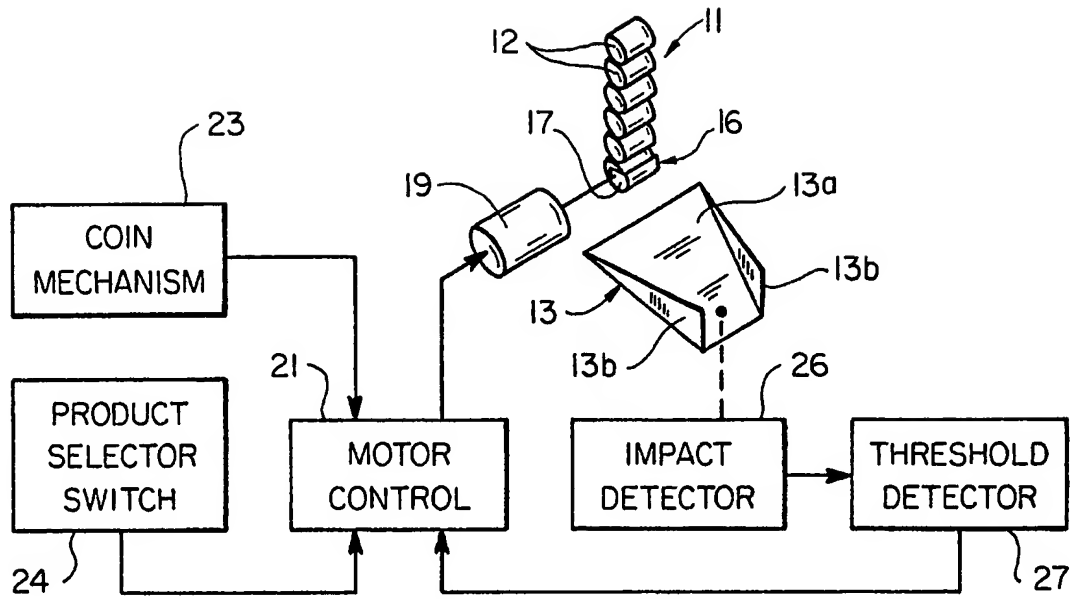
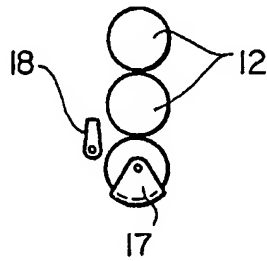


FIG. 1

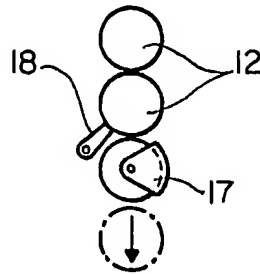
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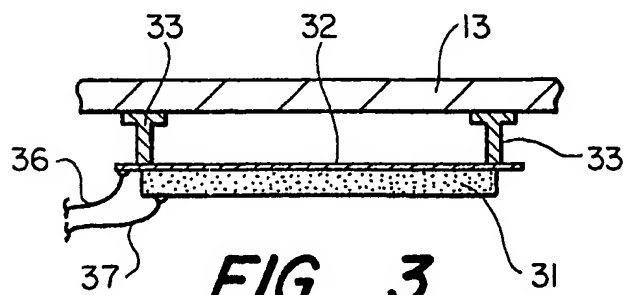
FIG_1



FIG_2A
(PRIOR ART)



FIG_2B
(PRIOR ART)



FIG_3

SPECIFICATION

Vended product sensor and method

5 This invention pertains generally to vending machines, and more particularly to a system and method for determining when a product has been vended by a machine.

Products such as canned soft drinks and the like
10 are commonly vended in machines in which the product is stored in stacks or columns and dispensed from the bottom of the stack or column. Examples of machines of this general character are described in U.S. Patents 4,245,755 and 4,454,961.

15 These machines include a mechanism for releasing the lowermost product in the stack and dropping this product onto a delivery chute which leads to an access station where the customer receives the product. As described in U.S. Patent 4,454,961, the
20 vending machine comprises a semi-cylindrical bucket which rotates about the lowermost product, with cams and switches for determining the position of the bucket. During a vend cycle, the bucket rotates from a holding position beneath the lowermost product to a dispensing position to the side
25 of or above the lowermost product and back to the holding position beneath the next product in the stack. This cycle is initiated upon the deposit of coinage and the closure of a product selection
30 switch by the customer, and it is terminated when the cam operated switches indicate that the bucket has rotated back to the holding position.

In these machines it is assumed that the customer has received the product when the machine
35 has completed its cycle, and it is possible that the customer may not actually receive the product in the event of a jam or other malfunction in the machine. In addition, being mechanically actuated, the sensing switches are subject to wear, misalignment and breakage, which can disable the machine
40 or cause it to malfunction.

According to the present invention a vending machine comprises a supply station for holding a product to be vended, a product receiving member,
45 vending means for delivering the product from the supply station to the product receiving member when actuated, an impact detector for detecting an impact of the product on the product receiving member, and means responsive to the impact detector
50 for deactuating the vending means when the product impacts upon the product receiving member.

The vending mechanism is actuated by the deposit of coinage and the actuation of a product selection switch, and it continues to operate until the
55 impact is detected or a control time limit is reached. In one embodiment the impact detector comprises a piezoelectric element mounted on the delivery chute, and in other embodiments it comprises a strain gauge or a sound detector.

It is an advantage of the invention to provide a vending machine with a new and improved sensor
60 for determining when a product has been vended.

Another advantage of the invention is to provide
65 a sensor of the above character which is economical

to install and reliable in operation.

Another advantage of the invention is to provide a sensor of the above character which is easily installed on existing machines.

70 According to a further aspect of the invention there is disclosed a method of vending a product from a machine including the steps of storing a plurality of products in a stack in the machine, actuating a vending mechanism to deliver the lowermost product in the stack to a product receiving member, sensing the impact of the product upon the product receiving member, and deactuating the vending means in response to the impact.

Particular embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings of which;
80 *Figure 1* is a schematic drawing of one embodiment of a vending machine with a vended product detector according to the invention.

85 *Figures 2A* and *2B* are operational views of the vending mechanism in the embodiment of *Figure 1*.

Figure 3 is a cross-sectional view illustrating one method of mounting the impact detector on the delivery chute in the embodiment of *Figure 1*.

90 As illustrated in *Figure 1*, the vending machine includes a supply station 11 in which a plurality of products 12 to be vended are stored in a vertically extending column or stack. In this particular example, the product is packaged in generally cylindrical containers or cans which are stacked on their
95 sides, with the axes of the containers extending in a generally horizontal direction. However, the invention is not limited to products packaged or stacked in this particular manner, and it can be utilized with other products packaged or stacked in any suitable manner. It can also be utilized with products which are vended without packaging.

Products from stack 11 fall onto a delivery chute
100 13 which carries them to an access opening (not shown) in the cabinet of the machine where they are received by the customer. The delivery of products from the stack to the chute is controlled by a vending mechanism 16 which can, for example, be
105 of the type described in detail in U.S. Patent 4,454,961. Briefly, this mechanism comprises a generally semi-cylindrical bucket 17 which rotates about a horizontally extending axis and the lowermost product in the stack between holding and dispensing positions, as illustrated in *Figures 2A*
110 and *2B*. In the holding position the bucket is positioned beneath the lowermost product in the stack, and this product rests in the bucket. In the dispensing position, the bucket is positioned to one side of or above the lowermost product, and this product
115 is free to fall by gravity onto the delivery chute. A pivotally mounted gate 18 is linked to the bucket. This gate holds the next product in the stack above the lowermost product when the bucket is in the dispensing position, and it permits the next product to drop into the bucket when the bucket returns
120 to the holding position.

The vending mechanism is driven between the holding and dispensing positions by a motor 19
125 which is controlled by motor control 21. The motor

control receives a signal to actuate the motor at the outset of a vending cycle upon deposit of appropriate coinage in a coin mechanism 23 and actuation of a product selection switch 24. Once
5 actuated, the vending motor continues to operate until a product is dropped onto the delivery chute or the system times out without a product being dispensed.

The delivery chute is fabricated of sheet metal or
10 another suitable material, and it includes a downwardly inclined and tapered bottom wall 13a and a pair of upstanding side walls 13b. Products dropping from the stack onto the chute deflect the bottom wall or cause it to vibrate, often producing an
15 audible sound.

The impact of a product upon the delivery chute is detected by an impact detector 26 which provides an electrical signal having a magnitude corresponding to vibration of bottom wall 13a. The
20 magnitude of the electrical signal is monitored by a threshold detector 27 which provides an output signal to motor control 21 when the magnitude of the vibration corresponds to that produced by a
25 product impacting upon the chute. The threshold level is set in accordance with the weight of the product and the distance which it drops before impacting upon the chute. The impact detector is preferably mounted on the underside of the
30 delivery chute.

In the embodiment of Figure 3, the impact detector comprises a piezoelectric ceramic disk 31 mounted on the underside of a thin brass plate 32. This plate is spaced from the chute and supported by a pair of mounting arms affixed to the lower
35 side of the chute. Electrical connections to the detector are made by leads 36, 37 connected to the piezoelectric element and to the brass plate, respectively. In this embodiment, the piezoelectric disk has a diameter on the order of 1 inch, and it is
40 mounted in a central position on the underside of the delivery chute with the piezoelectric tensor of the ceramic aligned for maximum energization of the ceramic by flexure of bottom wall 13a.

Alternatively, the impact detector can comprise a
45 strain gauge or a sonic detector such as a microphone. These elements can be mounted in any suitable location such as the underside of the delivery chute. A strain gauge can, for example, be bonded directly to the underside of the chute and
50 connected to a bridge circuit which produces an electrical signal corresponding to the stress produced by the impact of a product. A microphone can be positioned beneath the delivery chute and oriented to respond to sound waves produced by
55 the impact of the product on the chute. The impact detector can also comprise an accelerometer which provides an electrical signal in response to deflection or movement of the delivery chute.

Operation and use of the sensor and therein the
60 method of the invention are as follows. The vending mechanism is normally in the holding position illustrated in Figure 2A, and the products are thus retained in the stack. When the appropriate coinage is deposited in the coin mechanism and a
65 product selection switch is actuated by a customer,

motor control 21 turns on motor 19, and bucket 17 begins to rotate. When the bucket reaches the dispensing position illustrated in Figure 2B, the lowermost product in the stack is released and drops
70 onto delivery chute 13, with gate 18 preventing the remaining products from dropping while the bucket is in the dispensing position. The impact of the product on the delivery chute is detected by impact detector 26 which produces an electrical
75 signal corresponding to the magnitude of the impact. If this signal equals or exceeds the level set by threshold detector 27, motor control 21 turns off the vending motor to terminate the vending cycle when bucket 17 returns to the holding position and
80 the next product drops into the bucket. In the event that the impact of a product on the delivery chute is not detected within a predetermined time, a timer in the motor control turns off the vending motor, and the transaction is voided. In this case,
85 the customer's money may be returned, or he may be asked to make another selection.

While the invention has been described with reference to a machine having a single stack or column feeding into a single delivery chute, it can
90 also be employed with machines having multiple stacks or columns feeding into one or more delivery chutes. In some cases, it may be desirable to use more than one sensor for a given delivery chute, for example with products dropping onto
95 different areas of the chute from different stacks, products of different weights, and products dropping from different heights. In such cases, the sensing elements can be positioned in areas where the vibrations produced by the impact of a product
100 are maximized.

The invention can also be utilized with machines having an intermediate shelf or other receiving member onto which a vended product drops initially from the supply stack. The product is typically carried by a conveyor from the intermediate
105 member to the delivery chute or directly to the customer. In such machines, the impact of the product upon either the intermediate member or the delivery chute, or both, can be detected.

The invention has a number of important features and advantages. It is economical to manufacture, easy to install, and can be installed easily on many existing machines. It provides a reliable indication when a product is delivered in a vending
115 operation, and it is a difficult system to defeat from the standpoint of security. The system has no moving parts, and it is substantially more durable than the cams and switches of the prior art.

It is apparent from the foregoing that a new and improved vended product sensor and method have
120 been provided. While only certain presently preferred embodiments have been described in detail, as will be apparent to those familiar with the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

CLAIMS

1. In a vending machine: a supply station for
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holding a product to be vended, a product receiving member, vending means for delivering the product from the supply station to the product receiving member when actuated, an impact detector
5 for detecting an impact of the product on the product receiving member and means responsive to the impact detector for deactuating the vending means when the product impacts upon the product receiving member.

10 2. The vending machine of Claim 1 wherein the impact detector is mounted on the product receiving member.

3. The vending machine of Claim 1 wherein the impact detector comprises a piezoelectric element.

15 4. The vending machine of Claim 1 wherein the impact detector comprises a strain gauge.

5. The vending machine of Claim 1 wherein the impact detector comprises a sound detector.

20 6. The vending machine of Claim 1 wherein the impact detector comprises an accelerometer.

7. The vending machine of Claim 1 wherein the impact detector comprises a pair of arms depending from the underside of the product receiving member, a thin flat plate mounted on the arms and
25 spaced below the underside of the product receiving member, and a piezoelectric crystal element attached to one side of the plate.

8. The vending machine of Claim 1 wherein the impact detector provides an electrical signal in response to vibration of the product receiving member, and the means for deactuating the vending means includes means for sensing the level of the electrical signal and deactuating the vending means when the signal exceeds a predetermined
35 level.

9. The vending machine of Claim 1 wherein the product receiving member comprises a delivery chute.

10. The vending machine of Claim 1 wherein the product receiving member comprises a shelf within the machine from which the product is delivered to a customer.

11. In a vending machine: a stack of product to be vended, a product receiving member positioned
45 below the stack of product, vending means which removes the lowermost product from the stack and drops said product upon the product receiving member when actuated, an impact detector for detecting the impact of the product on the product
50 receiving member, and means responsive to the impact detector for deactuating the vending means when the product impacts upon the product receiving member.

12. The vending machine of Claim 11 wherein the product is contained in generally cylindrical containers which rest on their sides in the stack.

13. The vending machine of Claim 11 wherein the impact detector is mounted on the underside of the product receiving member.

60 14. The vending machine of Claim 11 wherein the impact detector comprises a piezoelectric element.

15. The vending machine of Claim 11 wherein the impact detector comprises a strain gauge.

65 16. The vending machine of Claim 11 wherein

the impact detector comprises a sound detector.

17. The vending machine of Claim 11 wherein the impact detector comprises an accelerometer.

18. The vending machine of Claim 11 wherein
70 the impact detector provides an electrical signal in response to vibration or movement of the product receiving member, and the means for deactuating the vending means includes means for sensing the level of the electrical signal and deactuating the vending means when the signal exceeds a prede-
75 termined level.

19. In a method of vending a product from a machine, the steps of: storing a plurality of products in a stack in the machine, actuating a vending
80 mechanism to deliver the lowermost product in the stack to a product receiving member, sensing the impact of the product upon the product receiving member, and deactuating the vending means in response to the impact.

20. The method of Claim 19 wherein the impact is sensed by detecting vibration of the product receiving member.

21. The method of Claim 20 wherein vibration of the product receiving member is detected by a
90 piezoelectric element attached to the product receiving member.

22. The method of Claim 20 wherein vibration of the product receiving member is detected by a strain gauge attached to the product receiving
95 member.

23. The method of Claim 20 wherein vibration of the product receiving member is detected sonically.

24. The method of Claim 19 wherein the impact
100 is sensed by detecting movement of the product receiving member.

25. The method of Claim 24 wherein movement of the product receiving member is detected by an accelerometer.